Proposed Bill No. 5608

My name is Derek Anneser and I am a Mechanical/Sales Engineer for Anneser Associates and Norris & Ferraris. I have been asked by the Mohegan Sun to talk about their Air Handling Systems and their state-of-the-art Indoor Air Quality Systems.

I have been involved with Mohegan Sun since they opened. We have installed IAQ devices in ALL OF THE AIR HANDLING SYSTEMS THAT SERVE PUBLIC AREA'S. All of the Air Handling Unit Systems have been designed by Professional Engineers using the latest ASHRAE Standards (STD 62-89 through the current Standard 62.1.2007). The ASHRAE Standard is the professional guide for mechanical engineers for designing the correct amount of Ventilation Air Requirements in Occupied Spaces. My experience with the Mohegan Sun is that they have stressed the importance of proper ventilation in both the design and operations of the systems.

The current ASHRAE Standard 62.1.2007, Section 6.2.9 in reference to Ventilation in Smoking Areas states, "Smoking areas shall have more ventilation and/or Air Cleaning than comparable no-smoking areas. Specific ventilation rate requirements cannot be determined until cognizant authorities determine the concentrations of smoke that achieves an acceptable level of risk. Air from smoking areas shall not be re-circulated or transferred to no-smoking areas." Mohegan Sun has met and exceeded this Standard by using IAQ devises and using more ventilation air than required by the standard.

Section 8.4.1.1 of the Standard titled Filters and Air Cleaning Devises states, "All filters and air cleaning devises shall be replaced or maintained as specified by an O&M Manual." Mohegan Sun has contracted Anneser Associates to service and maintain the IAQ devises in all of the Air Handling Systems. I work with their PM (Preventive Maintenance Crew) to inspect, test and monitor the IAQ systems. The PM crew changes all of the filters (on a timed filter change-out schedule) and monitors the indicating lights on the IAQ systems.

The Mohegan Sun has three different types of "State-of-the-art Indoor Air Quality Systems" operating in their facility.

- Dynamic Air Filters – These filters systems are used in all of the Hotel Smoking Rooms. Mohegan Sun took the pro-active approach three years ago to remove the standard MERV -2 Filters from the Hotel Vertical Fan Coil Units and Install the Dynamic Filters equal to a MERV-12. These filters are designed to remove the smoke and contaminants from the hotel rooms. These systems are also used for "spot air purification needs" in the facility.

- CosaTron – This system has been around for the past thirty years and uses a high voltage and high frequency to agglomerate smoke particles together to make them large enough to be caught in either the MERV 8 Prefilter or the MERV 14 Final Filters. This system is used in all of the Mammoth Rooftops, York Air Handling Units and Heatex Units.
- SecureAire – This is the newest IAQ Technology in our industry. It uses a particle conditioning system to coagulate the particles together. These systems are used in the Innovent and Temtrol Air Handling Units (Casino of the Wind) which also use a MERV 8 Prefilter and a MERV 14 Final Filter.

I can provide more detailed explanations of how these systems work after this meeting if anyone has any specific interest in them.

All of the IAQ devise are designed to agglomerate or coagulate the fine particles in the air and make them larger. The advantages of these systems is that it works for smoke (typical particle size is .2 to 1.2 microns in size) but all other fine particles in the air, including {Viruses, Bacteria's, mold spores, pollen and dust}. Mohegan Sun has very high ceilings in most of the gaming areas. This is a huge benefit for IAQ – specifically smoke. When lit, cigarette smoke is 90% hot gas and 10% particulate. As the hot gas (smoke) rises it cools and changes state to 90% particulate and 10% gas. The high ceilings allow the smoke to rise away from the employees and patrons. The smoke is then induced towards the return air duct systems, drawinig it back to the Air Handling Units where it gets filtered and agglomerated/coagulated and the air cleaning process begins again. Another advantage of the high ceilings is the resorvoir of air in the space. These are large open area's with the duct returns high, so the airflow is drawn away from the patrons and employees.

The above IAQ systems typically reduce the amount of particulate (smoke and other fine particles) by 60 to 90% based on independent test data. These systems require little electrical input (equal to a light bulb) and only add .1" of static pressure to the air systems (very little). These IAQ products are designed for Hospital Facilities, Gaming Facilities, and Clean Rooms etc.

Derek Anneser

Anneser Associates/Norris & Ferraris

Cell (860) 819-1898

Furnace Filter Care

Have A Question?

Need Help?

Contact Us

BOOKMARK

Understanding MERV Ratings

MERV ratings are used to rate the ability of an air conditioning filter to remove dust from the air as it passes through the filter. MERV is a standard used to measure the overall efficiency of a filter. **Higher MERV ratings mean** fewer dust particles and other airborne contaminants pass through the filter.

MERV ratings are **determined by adding particles of varying sizes (1-12) into a controlled testing environment**. The particles are added upstream of the test filter and a laser particle counter samples the air before it enters the filter and after it leaves the filter. The two particle counts are compared to calculate the Particle Size Efficiency of the tested filter. Once this is determined, a MERV Parameters chart is used to determine the MERV rating.

MERV **ratings range from 1 - 16** and measurements are in microns. Some of the common particles related to MERV ratings are **pet dander, insecticide dust, smog, dust, viruses, wood, tobacco smoke, spores, bacteria and pollen.**

Some of the most common filters found in residential use only have a **merv rating of 1 to 4**. These are typically disposable panel type filters and do not do a good job of filtering the air because they will not stop particles smaller than 10 microns.

Merv 5 to 8 rated filters are a better choice and are more commonly found in commercial applications. These filters will collect particles as small as 3 microns and are a good choice for home owners also.

Filters with a **merv rating of 9 to 12** are used in commercial and industrial applications and will stop particles in the 1 to 3 micron range. These filters are a great choice for home owners who want the best dust control possible. When using filters with Merv 9 ratings and above it is important to clean or replace them when recommended by the manufacturer because they will have a negative effect on air flow when they become dirty. This can lead to performance problems and decreased operating efficiency.

The most efficient filters have **merv ratings of 13 to 16** and will stop particles as small as .3 microns. These filters are used in hospitals and other super clean environments.

We hope you find valuable information in the table below. If you would like to read more about the different furnace filter options and some of the benefits of each, checkout the some of our other pages. Media Air Filters, Pleated Air Filters, HEPA Air Filters, Activated Carbon Air Filters

Electrostatic furnace filters are not listed in the table because they do not have MERV ratings. Arrestance and resistance are terms more commonly used to rate electrostatic filters.

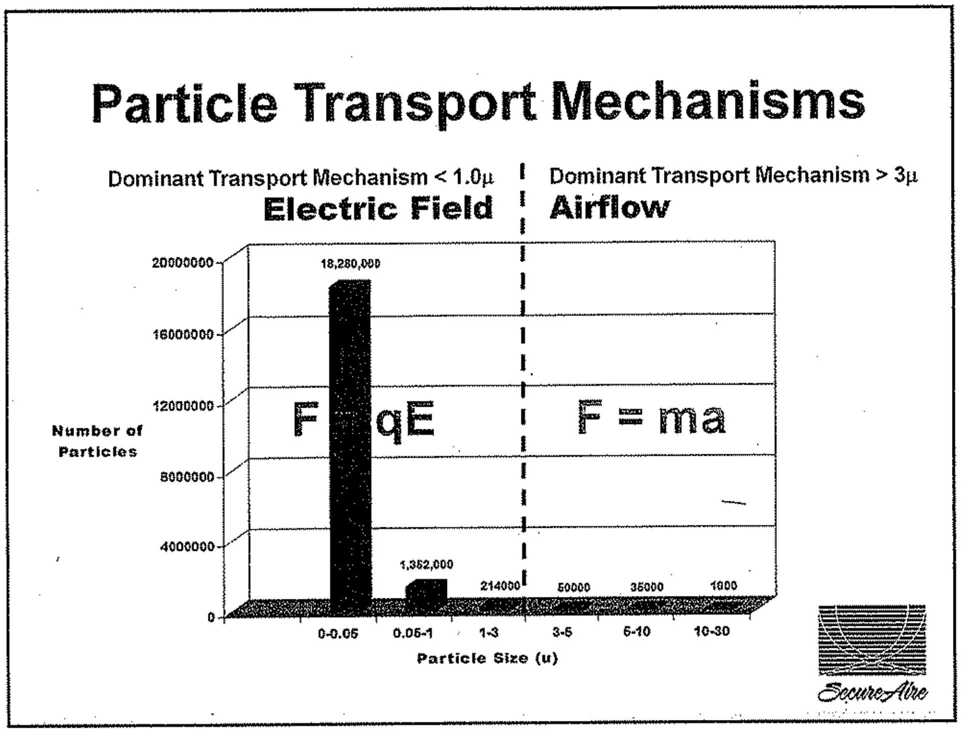
MERV Filter Efficiency Guide

Arrestance	Efficiency	MERV Rating	Types Of Filters	Tested Contaminant
60-80%	> 20%	1 - 4	Disposable Panel Filters, Permanent Metal Filters, Fiberglass & Foam Media, Hogshair, Automatic Rolls	Pollen, Spanish Moss, Dust Mites, Sanding & Spray Paint Dust, Textile & Carpet Fibers
80-90%	> 20%	5	Pleated Panel Filters, Ring Panel Filters, Synthetic Media	Pudding Mix, Snuff, Powdered Milk
90-95%	20-30%	6	Cube Filters, Self-Supported Filters	Dusting Aids, Cement Dust
90-95%	25-30%	6-7	Pleated Panel Filters	Hair Spray, Fabric Protector
95-98%	40-50%	8	Pleated Panel Filters, Ring Panel Filters, Extended Surface Pocket Filters	Mold Spores
98%	50-60%	9-10	Extended Surface Pocket Filters	Welding Fumes, Nebulizer Drops, Coal Dust, Auto Emissions
99%	60-70%	10-11	Pleated Panel Filters, Extended Surface Pocket Filters, Rigid Cell Filters	Lead Dust, Milled Flour

Demonstration of the effect a dirty furnace filter has on air flow.

99%	80-90%	12-14	**Pleated MERV 12 Nordic Pure Filters** Extended Surface Pocket Filters	Legionella, Humidifier Dust, Smoke, Copier Toner, Rigid Cell Filters, Face Powder, Paint Pigments, Insecticide Dust
99%	90-95%	14-15	**HEPA-Pure Pleated** Extended Surface Pocket Filters, Rigid Cell Filters	Sneeze, Cooking Oil
NA	95%	16	Rigid Cell Filters	Bacteria, Tobacco Smoke

Understanding Furnace Filter Ratings
There are some important terms used to rate furnace filters and air conditioner filters. Typically you will see air cleaners, electrostatic filters and electronic filters rated by efficiency only and they will not be given a MERV rating.



It is a known fact that as particle size gets smaller there are more of them.

- For example if we took a cubic foot of outside air and measure the number of particles in it we would find that there would be a thousand 10-30 micron size particles in that cubic foot of air. In that same cubic foot of air there would be thirty five thousand 5-10 micron size particles. There would be one million three hundred and fifty two thousand 0.5 to 1.0 micron particles. Finally, at less than 0.5 microns, as far a typical cleanroom high resolution particle monitor (down to 0.1 microns) could measure, there are eighteen million two hundred and eighty thousand particles in that same cubic foot of air.

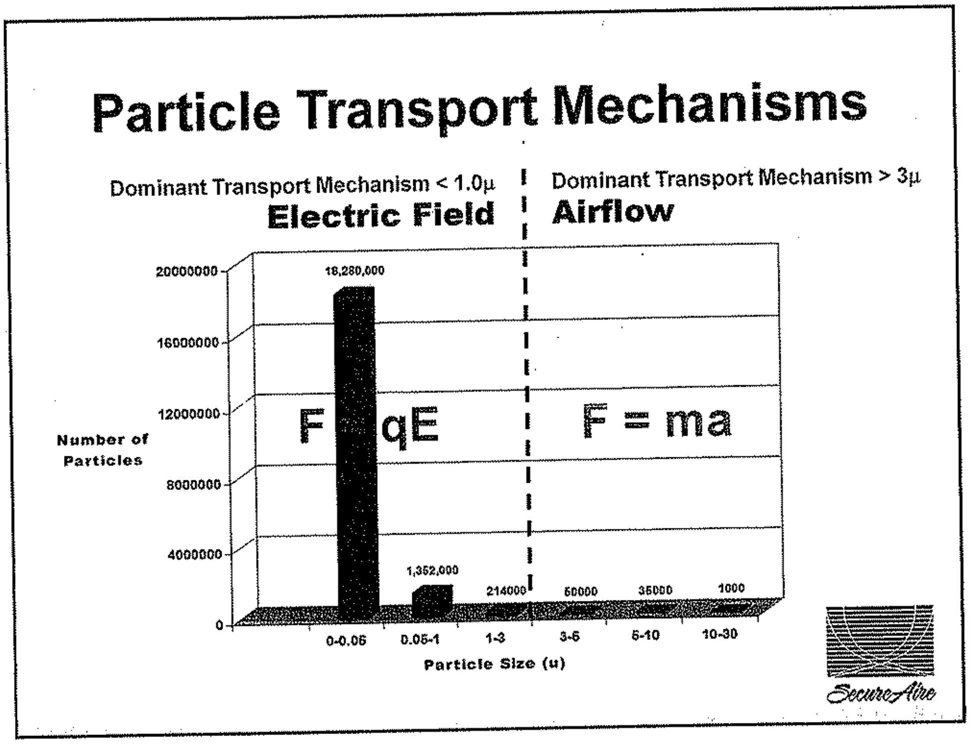
So, there are 18,280 times more particles in air at 0.5 microns than there are at 10 microns. What this means is that 98.4949% OF THE PARTICLES IN AIR ARE LESS THAN A MICRON IN SIZE

- ***Small particles, as you will see, are causing most of the problems in a building environment.***
- ***Small particles are the hardest to control from a contamination standpoint.***

In the different environments mentioned, the object, is the same;

1. Keeping the contaminants entrained in the airflow supplied by the HVAC equipment so they can be removed from the building environment.
2. Doing this requires understanding of the transport mechanisms in the building environment.

This understanding is the foundation behind Particle Accelerated Collision Technology (PACT).



It is imperative that the transport mechanisms are under control for particle reduction in the occupied space.

<u>Transport mechanisms are what makes particles (or contaminants) move from point A to point B.</u>

- *In every building environment there are forces present that determine these transport mechanisms.*
- *The major types of forces on particles in a building are caused by **airflow** and/or **electromagnetic** forces.*

Note: Particles in the micron size range are essentially not influenced by gravity. Even a 100 micron sized particle takes 8 seconds to drop 8 feet. A one micron sized particle takes 19 hours to drop 8 feet and a 0.1 micron particle takes 79 days to settle 8 feet!

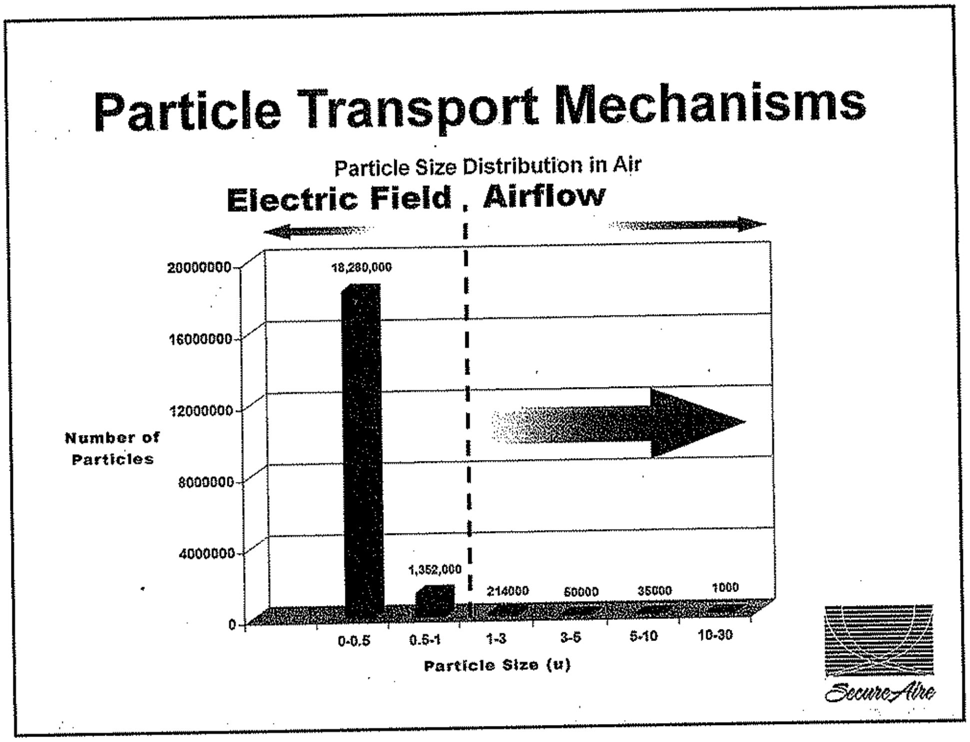
For small particles the dominating transport mechanism is electromagnetic fields.

Note: As can be seen from the graph above, almost all particles are dominantly influenced by the electrical transport mechanism since almost all particles are less than a micron in size.

- In building environments there exist complex electrical fields that interact with particles.
- These interactions determine the deposition of contaminants in and on people, objects, ductwork, furniture and walls.
- The sources of these fields are the electrical lines and cables in the wall, fluorescent lights, computers, people, etc.
- **For larger particles, airflow has a much greater influence.**
- These particles have less free charge associated with them and they have more mass so that the electrical fields do not influence them as much.
- As a result the dominant transport mechanism is airflow for particles greater than approximately 3 - 5 microns.
- These larger particles tend to stay entrained in the air and get back to the filter for removal.
- The large particles we are referring to only make up about 1 % of the contamination in a building environment.
- The driver for the airflow transport mechanism is the HVAC equipment in a building.

<u>In summary:</u>

1. As the particle size decreases the effect of the electrical field is dominant.
2. As the particle size increases the effect of airflow becomes more dominant.
3. For very large objects the effect of gravity dominates (that is why a desk doesn't fly around the room).



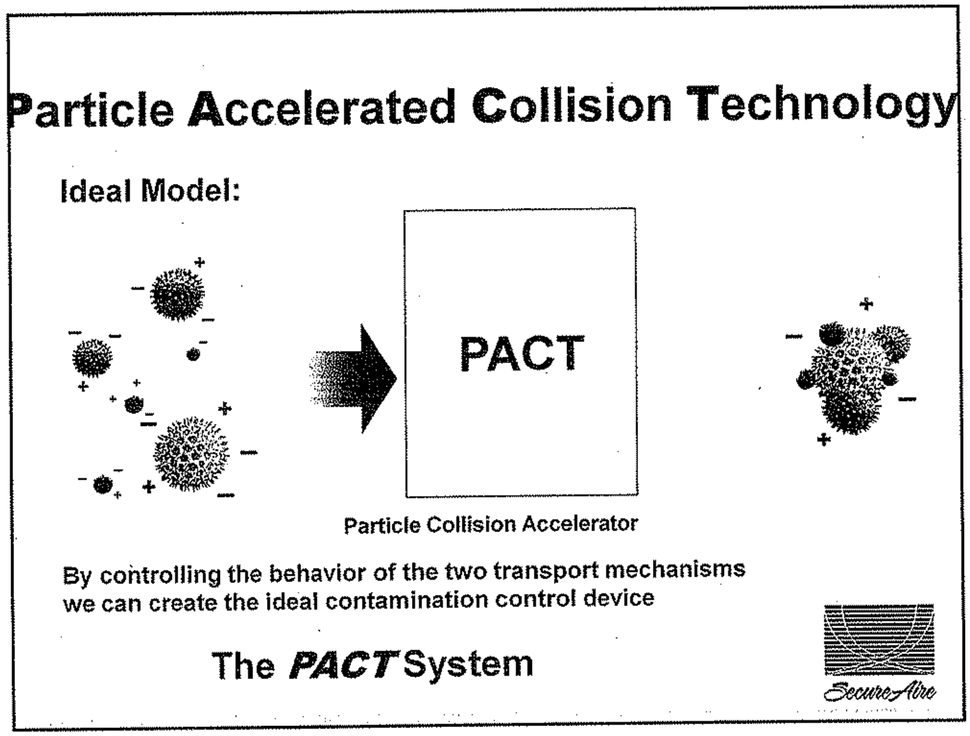
- ***What happens when particles collide with one another?***

1. They adhere to each other to form larger particles.
2. With a consequential continuous decrease in the number of particles and an increase in particle size.
3. This collision process is caused by Brownian motion (thermal coagulation), and or kinematic coagulation.

- **Coagulation is the most important phenomenon for the interactions between particles.**

- Electrical forces between particles can increase coagulation by enhancing Brownian motion. This is happening in nature all the time.

Note: Collisions of particles with opposite charges increase but collisions between particles of the same charges are reduced. Therefore the net effect is little change in coagulation for particles in air. However, if these particles are treated properly there will be a significant increase in coagulation. Particles will attach firmly to any surface they come in contact with, not just to each other. For sub-micron particles, the small ones, these adhesive forces, such as Van deer Waals forces, electrostatic forces, and surface tension (all electrical forces) are extremely strong and far exceed the removal forces. Removal forces are mostly caused by airflow. Therefore, the smaller the particle the stronger the adhesive force and the less likely it can be removed from a surface (remember, small particles have more charge on them). Particles less than a couple of microns in diameter will not be removed by the forces found in HVAC equipment. This is because they will adhere to ducts and room surfaces and they will stay there, period. Now, if we can make the particles bigger, coagulate them, they can be easily dislodged by airflow and can be kept entrained in the air.



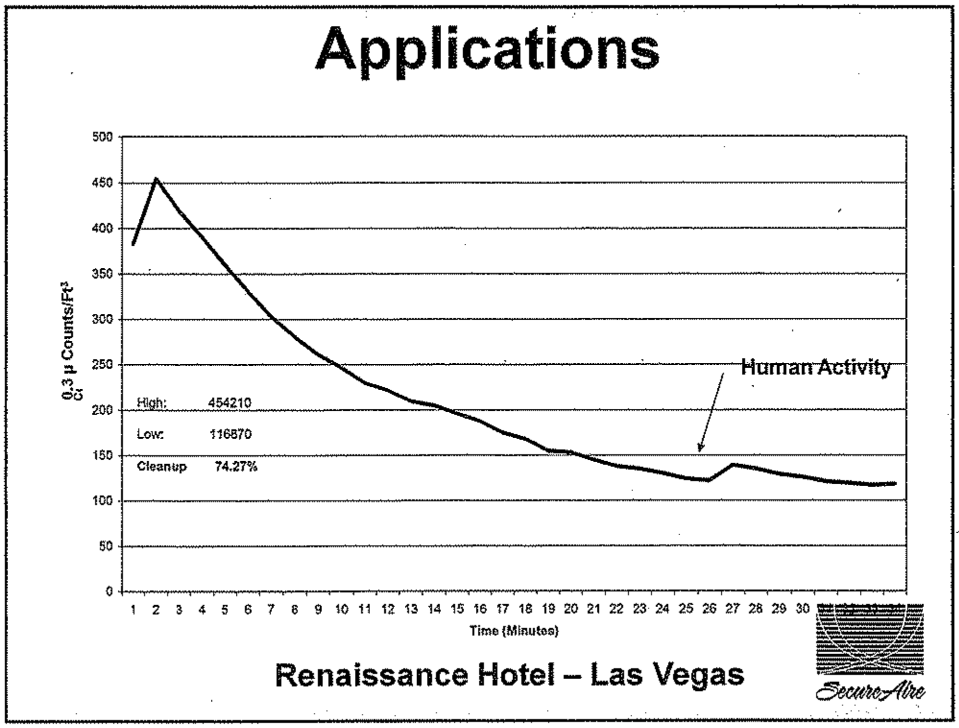
The objective of PACT is simple;

- It is to take all contaminants out of the occupied space and essentially make every room a clean room by using the properties of collision acceleration and transport mechanism control.

- Most particles going into the PACT system are small and are influenced by the electrical field transport mechanism.
- When particles leave the PACT system the collision process has been initiated.
- They are made large enough to be controlled by airflow and thus get taken throughout the room, colliding with other particles, chemicals and gases which adhere to them.
- Then they get exhausted or go to the filter where they are efficiently collected and eliminated.

PACT does two things:

1. **Causes collisions between sub-micron sized particles to form larger particles**, thus changing them from being dominantly controlled by the electrical field transport mechanism to being controlled by airflow.
2. **Makes particles more neutral in charge**. Particles will not only stay entrained in the airflow without being influenced by the electric field but will not be as likely to form strong bonds with surfaces and objects even if they should come in contact with them.



Renaissance Hotel Application

Opportunity;

- An Air Purification System (APS) was employed to clean up the smoke odors in a smoking room.
- Particle levels were taken before and after the APS was utilized.
- A panel of 4 people (Housekeeping, Maintenance, Engineering, Director of Operations) was chosen to determine whether the room was acceptable for non-smokers.
- The Renaissance Hotel is unique in the sense that it has no casino and all rooms are non-smoking except for the 3rd floor.
- As can be expected, at times the hotel is full of occupants and the only available rooms are on the 3rd floor.

By using the APS it was hoped that the room air would be clean enough for non-smokers.

Experimental:

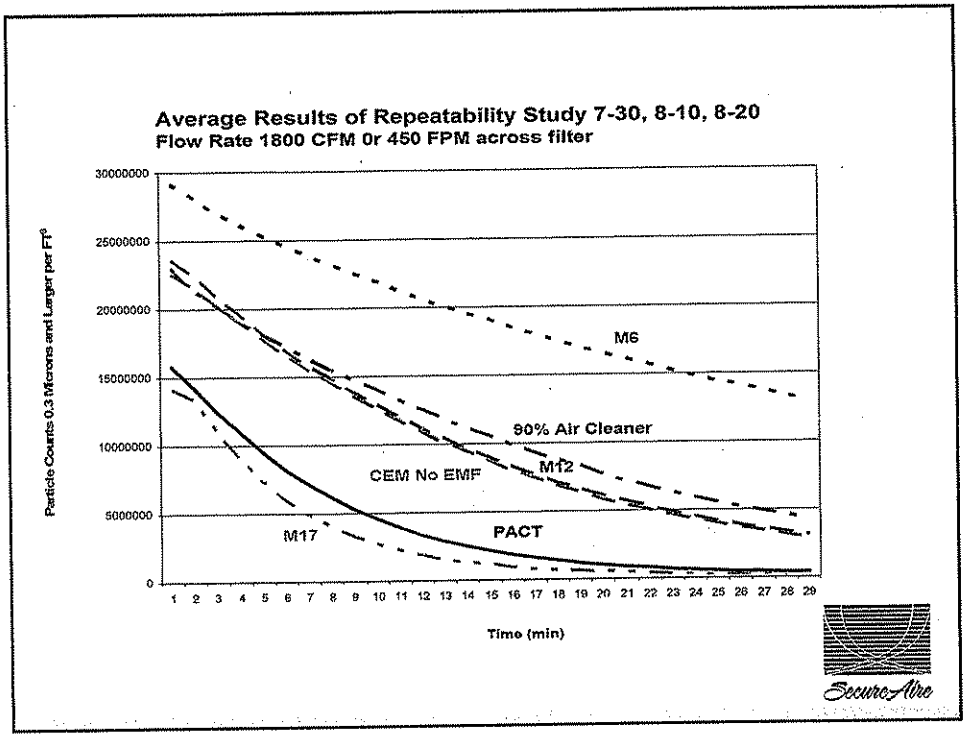
1. Particle count levels/ft3 at 0.5 microns were monitored in a specified room chosen by the Director of Human Services and the Housekeeping Manager before the APS was turned on. This gave us a background reading.
2. A panel of four people, including the two managers mentioned above and the HVAC engineer were used to determine if the odors were reduced to acceptable levels.
3. The APS was turned on and particle levels were again measured to quantify the results.

Note: any time there is a panel involved they are subjective to emotions and "sensory interpretations".

Results:

- Before employing the APS system the particle level at 0.5 microns was 424k counts/ft3.
- Employing the APS for 20 minutes decreased the particle level to 117k counts/ft3, thus giving a cleanup rate of 74%.
- The equivalent cleanroom rating after the test run with the APS was class 3k.

Note; Every one of the panel members said that the odor was virtually eliminated in the room (in 20 minutes).



Experimental;

- In this experiment an Air Purification System (APS-C) system was employed.
- The APS-C ran at 1800 CFM giving an air change rate of 18 ACH.
- The APS-C is a cabinet system used to condition the occupied space with a smaller footprint allowing it to be used in a desired location without mounting it to the ceiling.

- The above shows the results of the PACT system the 90% efficiency air cleaner, (only one 24x24" air cleaner was employed, thus sharply reducing its performance), and different type filters (MERV 6, MERV 12, and MERV 17).
- In this study the CEM was also employed, without PACT (Thus it was used as a filter media only).
- The above graph shows that the CEM is comparable to a MERV 12 filter when not electrified.

Note: This is an important observation considering that if the building loses power the system maintains a MERV 12 level of performance. Many air cleaners are virtually ineffective without electrification. Of course adding power to the CEM (CEM On) gives the results shown.

- The graph also shows the results for each air cleaner/filter employed.

- What comes out in the graph is two observations:

1. The single pass performance is indicated by the beginning of each plot. The better the first pass performance, the lower the particle counts (better single pass cleanup rate).
2. The overall cleanup rate.

As can be seen, the results can be divided into three groups;

1. The first is the MERV 6 filter which shows the lowest level of performance, as expected. Its average counts were at 30million (M) counts per cubic foot at startup and ended at 13 M counts per cubic foot of air. It didn't drop particle counts a single magnitude.
2. The second is the 90% air cleaner, the M12 and the CEM (used as only a filter). These decreased in particle rates from 23M down to 3M counts per cubic foot of air. This shows a magnitude of particle cleanup recovery. It shows a better first pass performance also, as can be seen by the graph.
3. The third is the PACT S and the MERV 17 filter. These decreased in particle rate from 15M down to 200,000 counts per cubic foot of air. This is two orders of magnitude of particle cleanup recovery. It also shows a much better first pass recovery rate and performance.

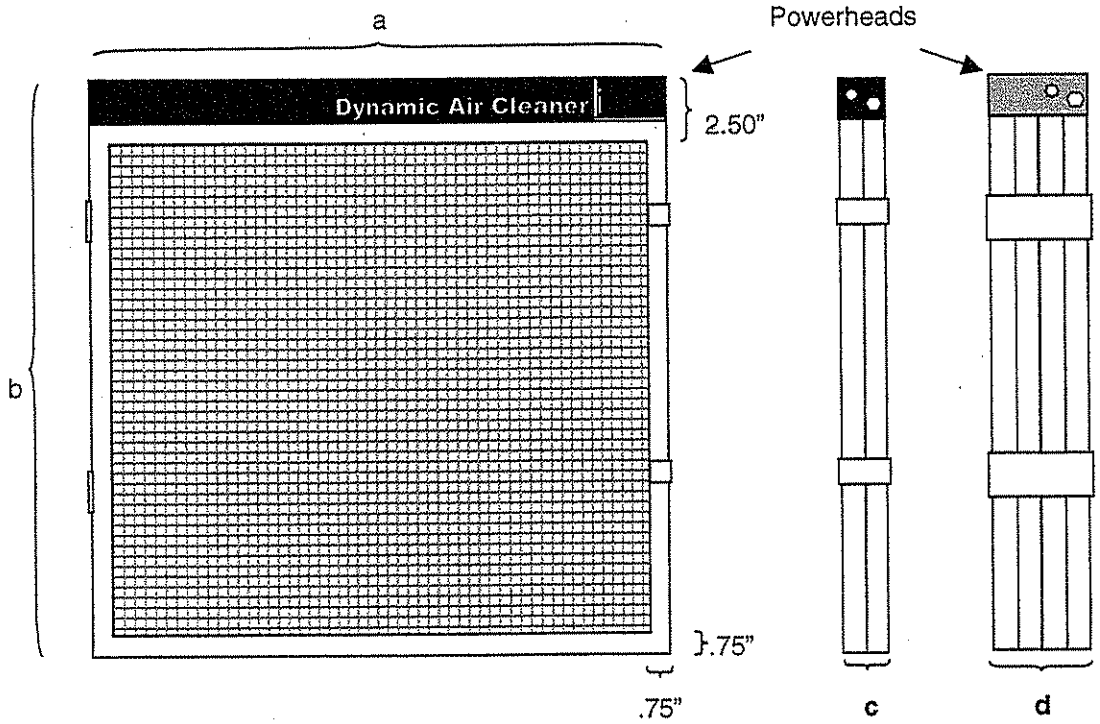
Environmental Dynamics Group
P.O. Box 1258
Princeton, New Jersey 08542
609 275-9660
fax 609 275-9788

Dynamic Air Cleaner.

Dynamic Air Cleaners: 1" and 2" Panel Air Cleaners

General

Dynamic Panel Air Cleaners are designed to retrofit into the existing filter tracks or grills of HVAC systems. The 24vac necessary to power the Dynamic can be taken off the existing 24vac controls transformer (most common residentially), a separate hard-wired transformer, or a plug-in transformer.



Standard Size 1" and 2" Panels—Recommended Configuration

a	12	14	14	14	15	16	16	16	16	16	16	18	18	18	20	20	20	20	24
b	24	20	25	30	20	16	20	21	24	25	30	18	20	24	20	24	25	30	24
c	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
d	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

Specifications

Electrical input:	24 vac
Powerhead output voltage:	6,500 vdc
Power consumption:	2 Watts
Volt/amps draw per Powerhead:	0.7VA
(Note: 2" Panels have two Powerheads)	
Max. recommended face velocity:	500lfpm

Configurations

-individual Panels
-electrical and/or mechanical Tandem
-front-load units for filter grills and front access racks
- "V"-banks

Environmental
Dynamics Group

Summary of Particulate Removal Capacity

Obtained from Independent Test Laboratories

Room Test

Room Size	11,000 cu. ft. (311.5 cu. M)
Air Flow Rate	400 CFM (0.19 M^3/second)
Particle Size Measured	0.3 – 0.5 Microns
Filter Used for Test	Panel Air Cleaner with aluminum center screen 12"x24"x1" (305mmx 610mx25.4mm)

Decrease in Particle Count in One Hour: 80%
Decrease in Particle Count in Two Hours: 97.2%

[Test performed by the University of Waterloo]

House Test

Test House Size	Estimated at 10,000 cu. ft. (283 cu. M)
Air Flow Rate	Standard Domestic Central Heater Air Flow Rate Estimated at 1200 CFM (0.556 M^3/second)
Filter Used for Test	Panel Air Cleaner with aluminum center screen 20"x20"x1" (508mm 508mmx25.4mm)

Particle Size (Microns)	0.3 – 0.5	0.5 – 1.0	1.0 – 5.0	7.5
Initial Count:	700,000	425,000	100,000	9,000
Count After Stabilization: (Approximately 10 Hours)	18,000	6,000	<1,000	<1,000
Percent Reduction:	97%	98.6%	>99%	>99%

[Test performed by Health & Welfare, Canada]

Chamber Test

Chamber Size:	7 cu. ft. (.20 cu. M)
Air Flow Rate:	300 CFM (0.14 M^3/second)
Particle Size Measured:	0.3 Microns
Filter Used for Test:	Panel Air Cleaner 12"x24"x1" (305mmx610mmx25.4mm)

Decrease in 0.3 Micron Particles
In One Minute: 80% (Average of Three Tests at 46% Relative Humidity)
82% (Average of Three Tests at 59% Relative Humidity)

[Test performed by Life Resources Institute]

Particle removal comparison to 99.97% HEPA filter

Room Size	260 cu. ft. (7.36 cu. M)
Air Flow Rate	300 CFM (0.14 M^3/seconds)
Filter Used for Test	Panel Air Cleaner 12"x 24"x1" (305mm 610mmx25.4mm)

HEPA Filter Removed 94% of 0.3 Micron Size Particles in 15 Minutes
DYNAMIC Filter Removed 89% of 0.3 Micron Size Particles in 15 Minutes

[Test performed by Life Resources Institute]

AppGuide®

CosaTron

BINGO HALLS AND CASINOS

PROBLEM:

The major problem is high levels of tobacco smoke and odors. Recent studies and experience indicate that 40-50% of the occupants may be smoking at the same time. Bingo Halls and casinos are generally crowded with people sitting in close proximity to each other. The occupants, both employees and participants, experience eye irritation and their hair and clothing become saturated with tobacco smoke and odors.

In non-smoking locations the problem of overall human generated contaminants still exists. Body odors, skin flaking, dander, dust, pollen, bioaerosols, etc., are additional factors causing serious levels of irritation to the occupants, especially sensitized individuals.

Airborne particulate contaminants vary in size. Many bacteria (99% exceed 1 micron in size) are attached to larger particles such as human skin flakes. Viruses generally occur in clusters or in and on other particles. Lung-damaging particles that may be retained in the lungs are 0.2 to 5 microns in size.

An often overlooked method of transportation of contaminants from floor to floor in buildings is elevator wells. They can start in subsurface structure areas in the building and can transport and distribute parking garage, basement and other odors and contaminants throughout the building. The stack effect experienced in many stairwells can cause pressurization problems between floors and cause infiltration and exfiltration of contaminants to and from those floors.

High humidities can support the growth of pathogenic species of fungi, associated mycotoxins, and dust mites. This growth is enhanced by the presence of materials with high cellulose, even with low nitrogen content, such as fiberboard, dust, lint, skin particles, and dander.

Microbial contamination in buildings is often a function of moisture incursion from sources such as stagnant water in HVAC air distribution systems and cooling towers. If the relative humidity in occupied spaces and low velocity ducts and plenums exceeds 70%, fungal contamination (for example, mold, mildew, etc.) can occur.

Owners or management of these facilities experience high costs for cleaning, such as light fixtures, and constant redecorating costs due to accelerated deposition and staining on surfaces.

SOLUTION:

The Solution to Pollution is Dilution. However, the source of that dilution air (**ventilation air**) is not necessarily outside air. It can be a combination of cleaned recirculated air and outside air.

For the purposes of this application guide, **ventilation air** <u>is</u> a mixture of recirculated and/or outside air which has been processed through a combination of filters and CosaTron.

Proper room air change rate (ventilation air), in combination with CosaTron and the recommended medium or high efficiency filter, typically solves the problems noted above.

Note: Human occupants produce carbon dioxide, water vapor, particulates, biological aerosols, and other contaminants. Carbon dioxide concentration has been widely used as an indicator of indoor air quality. Comfort (odor) criteria is likely to be satisfied if the ventilation rate is set so that 1000 ppm CO_2 is not exceeded.

Extracts from ASHRAE Standard 62-89

Ventilation for Acceptable Indoor Air Quality

PURPOSE: To specify minimum ventilation rates and indoor air quality that will be acceptable to human occupants and are intended to minimize the potential for adverse health effects.

This Standard specifies alternative procedures to obtain acceptable air quality indoors.

The **Ventilation Rate Procedure** provides one way to achieve acceptable air quality. This procedure prescribes the rate at which ventilation air [outside air] must be delivered to a space and various means to condition that air [filtration of the outside air].

ASHRAE Standard 62-1989
OUTDOOR AIR REQUIREMENTS FOR VENTILATION

Application	Estimated Maximum Occupancy p/1000 ft^2 or 100 m^2	cfm/ person	L/s person
Gambling Casinos	120	30	15

While these quantities are for 100% outside air, they also set the amount of air required to dilute contaminants to acceptable levels. Therefore, it is necessary that at least this amount of air be delivered to the conditioned space at all times the building is in use except when intermittent or variable occupancy is experienced.

Indoor Air Quality Procedure: Acceptable air quality is achieved within the space by controlling known and specifiable contaminants. This procedure provides an alternative performance method to the Ventilation Rate Procedure for achieving acceptable air quality. The Indoor Air Quality Procedure provides a direct solution by restricting the concentration of all known contaminants of concern to some specified acceptable levels. It incorporates both quantitative and subjective evaluation.

The Indoor Air Quality Procedure could result in a ventilation rate lower than would result from the first procedure, but the presence of a particular source of contamination in the space may result in increased ventilation requirements. Change in space use, contaminants, or operation may require a re-evaluation of the design and implementation of needed changes.

Recirculation with air-cleaning systems is also an effective means for controlling contaminants when using the Indoor Air Quality Procedure. The recirculation rate for the system is determined by the air-cleaning system efficiency. The recirculation rate must be increased to achieve full benefit of the air-cleaning system. The air-cleaning system used to clean recirculated air should be designed to reduce particulate and, where necessary and feasible, gaseous contaminants.

CosaTron RECOMMENDED DESIGN CONSIDERATIONS:

Indoor air quality is a function of many parameters including outdoor air quality, the design of enclosed spaces, the design of the complete ventilation (air distribution and return) system, the way this system is operated and maintained, and the presence of sources of contaminants and the strength of such sources.

Ventilation air for controlling contaminant concentration can be used for dilution or for sweeping the contaminants from their source. The **ventilation effectiveness** is defined by the fraction of the outdoor air delivered to the space that reaches the occupied zone. The availability of the ventilation air to mix in the occupied zone can be improved through recirculation or active mixing of the air in the space.

Ventilating systems shall be designed and installed so that the ventilation air is supplied throughout the occupied zone.

Outside Air System Considerations

Makeup air inlets and exhaust air outlets shall be located to avoid contamination of the makeup air. Contaminants from sources such as cooling towers, sanitary vents, vehicular exhaust from parking garages, loading docks, and street traffic should be avoided.

Outside Air System Considerations Continued...

The Application Guides for CosaTron supply a "Minimum % Outside Air Recommended" value in the CosaTron Air Change Rates table. This value is based on analytical data and over thirty-five years of experience in resolving indoor air quality problems utilizing the CosaTron concept and filtration systems available. However, when increasing the percentage of outside air, specific attention should be given to the maximum percentage of outside air that can be introduced and the expected quality of that outside air.

When the building air handler system is designed to utilize outside air on an economizer cycle or to provide variable amounts of make up air for process equipment or laboratory exhausts, the maximum quantity of outside air possible should be identified as a percent of the total supply air. The percentage of outside air and the quantity and type of contaminants in the outside air has an effect on the configuration and performance of any air purification or filtration system.

On systems that will be using more than 25% total outside air on constant volume, variable volume, or economizer cycles, please review the Application Guide entitled "25 to 100% Outside Air Applications" or contact your local CosaTron Representative or the Application Engineers at CRS Industries for assistance.

Installation of CosaTron with the recommended high-efficiency filters and the proper air change rate is essential for satisfactory CosaTron operation. Proper air change rates are shown in the following table:

CosaTron AIR CHANGE RATES

Ceiling Height In Feet	Air Change Rate Per Hour: Recommended VAV*	Air Change Rate Per Hour: Recommended CAV**	Air Change Rate Per Hour: Minimum CAV**	Minimum Outside Air Recommended [1]
30 to 45% Smokers				
8	N/A [2]	19	17	10 cfm/person
10	N/A [2]	18	16	or 15% o/a,
12	N/A [2]	17	15	whichever is
14	N/A [2]	16	14	greater
16	N/A [2]	15	13	
18	N/A [2]	14	12	
50 to 65% Smokers				
8	N/A [2]	22	20	15 cfm/person
10	N/A [2]	21	19	or 20% o/a,
12	N/A [2]	20	18	whichever is
14	N/A [2]	19	17	greater
16	N/A [2]	18	16	
18	N/A [2]	17	15	

Higher than 65% smokers contact CRS Industries, Inc.

* VAV = Variable Air Volume

** CAV = Constant Air Volume

[1] Note: In certain applications where design conditions and occupancies allow, the amount of outside air may be reduced. However, CRS Industries Application Engineers should review the application prior to designing or implementing CosaTron with less outside air than shown in the table.

[2] CRS does not recommend VAV type systems for this type application. Contact factory for assistance if VAV conditions are mandated by the specifying engineer.

Supply Air Distribution Systems:

In areas where tobacco smoke and odors are of prime concern, use of diffusers with perforated plates tends to reduce the mixing of the supply air with the air in the conditioned space creating a reduced efficiency of the CosaTron system. Air diffuser systems which promote aspiration effects or homogeneous mixing enhance the CosaTron effect.

1. The system should provide a good mixture of primary air (conditioned and filtered supply air) with secondary air (room air) throughout the space.

2. Return air grill surfaces should be a minimum of eight (8) feet above floor level. (Ceiling level return grills provide the most efficient smoke and haze removal.)

3. Single return grill designs should be avoided when possible. When single return grill systems are employed the supply air diffusers should be located to assure maximized air mixing around the full space perimeter and core. The short cycle affect of the supply air moving directly from the diffusers to the return grill will reduce the system's smoke and haze removal capability.

4. Diffuser throw should be considered carefully to maximize mixing of air without causing drafts on the employees and participants.

5. A dedicated exhaust fan taking air directly from the conditioned space should be interlocked to the supply fan to assure that a constant supply (10%) of outside air is available for oxygenation of the space. Backdraft dampers can be used to exhaust additional amounts of return contaminated air, but air balance is critical to assure contaminant removal from the conditioned space.

Contaminants from stationary local sources within the space shall be controlled by collection and removal as close to the source as practicable.

Continuous air delivery to the space promotes optimum control of contaminants and improved human comfort.

CosaTron Installation Considerations:

The CosaTron Electrodes occupy a minimum of 9" in the direction of air flow, between the filters and first coil. The air entering the electrodes should not be below 50° F because the product performance starts to decrease. We recommend that the air entering the electrodes be below 85% RH to prevent rapid corrosion of the electrical connections. If this cannot be accomplished, a non-hardening silicone grease should be applied to the connections to prevent corrosion.

CosaTron can function up to 850 FPM face velocity. However, the electrodes should be sized to prevent large changes in the air pattern. It is usually best to match the electrode size to the adjacent coil or filter rack. The area around the electrodes shall be bare metal. If the electrodes are not sized to match the plenum inside dimensions, a Plenum Sleeve should be specified along with blank off panels to prevent air bypass.

The power generator is not weather or waterproof. It must be located in an environment where it can breathe. On rooftop applications, it is recommended that the generator be located inside the air unit (the most common location is the fan section). The power generator should not be located in an area that experiences air at saturation. It cannot be located more than 9' wire length from the first electrode connection. The 110/120 VAC supply power to the generator should be wired through access door safety switches. (See the Mechanical and Electrical Installation Procedures for more details.)

Air Filters:

When light to moderate people density is expected, an 80% efficient final filter should be adequate. When moderate to high people density is expected, the system should employ a 90-95% efficient final filter. (ASHRAE rated. Based on ASHRAE 52 test method [current release].)

APPLICATION BENEFITS:

- Control of residual smoke, haze and odors in the conditioned space.
- Control of tobacco smoke and odors clinging to people and their clothing.
- Reduce eye irritation for patrons and employees.
- Reduce contaminant deposits on the heat transfer coils, fans and ductwork, maintaining air conditioning equipment efficiency.
- Reduce build-up of residual odors on furnishings and air handling equipment.
- Maintain cleaner light fixtures for a brighter playing area.
- Reduce outside air by utilizing the indoor air quality procedure in ASHRAE Standard 62-89.

REPRESENTATIVE INSTALLATIONS:

For an up-to-date list of representative installations, please contact your local CosaTron Representative or CRS Industries.

REFERENCES:

ASHRAE Standard 62-1989, Ventilation for Acceptable Indoor Air Quality. American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc., Atlanta, GA 30329. 1989.

Note: CRS recommends that all individuals involved in equipment supply or design of buildings for human occupancy should become familiar with this Standard.